IDENTIFICATION AND GRADING OF DISEASES OF HUMAN LUNGS USING MACHINE LEARNING TECHNIQUES

SYNOPSIS

Submitted By

MR. ARUNKUMAR CHANDAN
Ph.D. STUDENT
SRTMUN, NANDED

For the Degree of
DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

Under the guidance of

DR. SUDHIR JAGTAP
PROFESSOR
SWAMI VIVEKANAND MAHAVIDYALAYA, UDGIR DIST:LATUR

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,

NANDED - 431606, MAHARASHTRA, INDIA

TABLE OF CONTENTS

Sr. No	Contents	Page No.
1	Abstract	3
2	Introduction	3-7
3	Literature Review	7-13
4	Objectives	14
5	Methodology	14
6	Importance of the Study	14-15
7	Scope of study	15-16
8	Proposed work plan	16
9	Tentative Chapter Scheme	16-17
10	Year wise work of plan	17
11	Expected outcome	17
12	References	17-19

1. ABSTRACT :

Lung diseases are the disorders that affect the lungs, the organs that allow us to breathe and it is the most common medical conditions worldwide especially in India. The diseases such as pleural effusion and normal lung are detected and classified in this work. Identification and grading of disease in a human organ demands expert's opinion and the patients medications are completely dependent on the results given by that expert. However, there might be situations where experts may not be available or too busy. To tackle the emergencies, which arise due to lack of experts, in this work, we will design an algorithm that inputs an image (MRI or PET) or CT—one among these) to classify whether the lungs is diseased or non-diseased. If a lung is diseased, we try to identify which disease based on the symptoms and figure out the amount of degradation that the lung has gone through due to that disease. **For this purpose, we rely on the image and pattern recognition algorithms.**

The purpose of the work is to detect and classify the lung diseases by effective feature extraction through moment invariants, feature selection through pattern recognition algorithm and the results are classified by the Naïve Bayes and decision tree classifiers. The preprocessing techniques will remove the noises and the feature extraction are done to extract the useful features in the image and the feature selection technique will optimize the top ranking features that are relevant for the image and the classifiers are employed to classify the images and the performance measures are found for the same.

The result shows that I use three machine learning algorithms at different stages to obtain the required results.

2. INTRODUCTION :

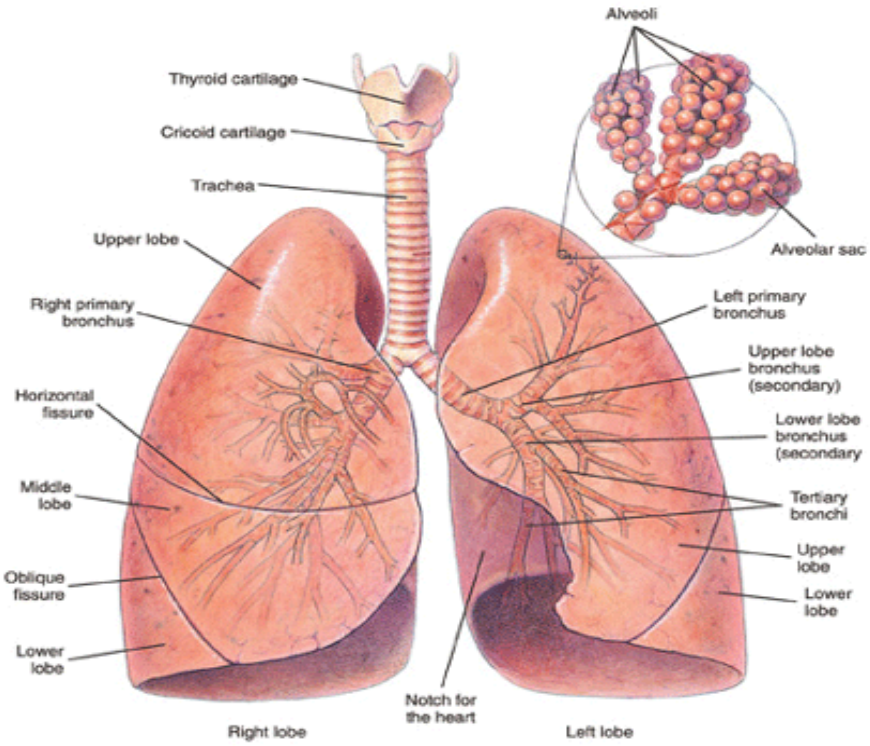


Fig: Healthy Lungs of Human

The term lung disease refers to many disorders affecting the lungs such as asthma, chronic obstructive pulmonary (COPD) disease, infections such as tuberculosis, influenza, lung cancer, pneumonia and other breathing problems. Lung diseases signs and symptoms can differ by the type of the affected disease. Common signs are trouble in breathing, shortness of breath, feeling like you're not getting enough air, decreased ability to exercise, a cough that won't go away, coughing up blood or mucus, pain or discomfort when breathing in or out.

Fig: Diseased Healthy Lungs of Human

Medical image analysis and process requires an environment for data access, data analysis, processing, revelation and algorithm development. Medical imaging is the technique and process used to create images of the human body for clinical purposes for diagnosis and analysis or medical science (including the study of disease of normal anatomy and physiology).In this paper, an automated approach for classification of the lung diseases using CT images is presented. The lung CT image is engaged as the input. Another look of the proposed system of lung diseases detection has been performed by using a set of CT images (pleural effusion and normal lung). The original image is transformed to gray scale image. After that, removal of the noises and contrast enhancement is done for obtaining the enhanced images. The median filter is applied to remove the salt and the pepper noises and the preprocessed images are given as input for feature extraction where the useful features of the images are extracted and the extracted features are selected by the pattern recognition algorithm method, the classifiers are used to classify the datasets in to relevant datasets and the

performance measures are evaluated for the datasets. This work helps as the assistant in detecting the lung diseases in the medical field .the motivation for choosing the work is to give the automated way of finding the diseases that affect our community most commonly.

In the recent years, medical CT Images have been applied in clinical diagnosis widely. It assists physicians to detect and locate pathological changes with more accuracy. Computed tomography images can be distinguished for different tissues according to their different gray levels. Lung diseases can be caused by infection, an exposure at the workplace, medications and various disorders. X-ray chest radiography and computer tomography (CT) are two common anatomic imaging modalities that are routinely used in the detection and diagnosis of a variety of lung diseases. Medical images play a vital role in patient diagnosis, therapy, surgical, medical reference, and training. The Digital Imaging and Communications in Medicine (DICOM) standard [1,17] allows storing textual descriptions, known as metadata, along with the images. It was the most important breakthrough since the discovery of the X-rays, and CT has remained a cornerstone of diagnostic radiology throughout the years. An excellent overview of its technology and applications is given by Kalender [2].

CT imaging had evolved far enough in terms of speed and resolution to make it a valuable tool in the imaging of the lungs [3]. CT lung image classification with correction for perfusion gradient was suggested by Chabat et al., [4]. However, the large number of features actually represents a problem. It leads to the ‘‘dimensionality curse’’ problem [5], where the indexing structures degrade and the significance of each feature decreases, making the process of storing, indexing and retrieving extremely time consuming. Pathologies are clearly identified using automated CAD system [6]. It helps the radiologist in analyzing the digital images to bring out the possible outcomes of the diseases. The medical images are obtained from different imaging systems such as MRI scan, CT scan, Ultrasound scans.

Pattern recognition algorithms (GAs) are among the most used techniques to perform feature selection due to GAs ability to obtain either exact or approximate solutions in very large search spaces within tractable time. GA performs adaptive searching, following the standard concepts from natural pattern recognition sand evolution based on natural selection [16]. Owing to their potential, GA is employed in this work to perform feature selection.

The proposed work is organized as follows, the input of the system is CT lung images for which preprocessing is done to enhance the image, feature extraction is carried out by the proposed fusion median absolute deviation techniques which fuse the features of the gabor filter and Walsh Hadamard transform, feature selection is through pattern recognition algorithm and the classification of the images is done through the classifiers and the performance measures, classification accuracy of each methods is discussed in this work.

3. LITERATURE REVIEW :

[1] Computerized lung sound analysis as diagnostic aid for the detection of abnormal lung sounds: A systematic review and meta-analysis

Arati Gurung [a], Carolyn G. Scrafford [b], James M. Tielsch [b], Orin S. Levine [b], William Checkley [a,b],*
a Division of Pulmonary and Critical Care, School of Medicine, Johns Hopkins University, Baltimore, MD, USA b Program in Global Disease Epidemiology and Control, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA Received 11 March 2011; accepted 11 May 2011 Available online 14 June 2011

This study is limited by the small number of available studies on the clinical utility of auscultation and computerized lung sound analysis for the diagnosis of abnormal lung sounds. Selected studies widely involved adult populations with the exception of Rietveld et al.8 who included children and adolescents with a mean age of 12 years. Gross et al.15 indicated that the spectral components of lung sounds have slight variance among different age groups, particularly in infants and children. Therefore, the findings of this study could not be directly applied to a pediatric population. In summary, electronic auscultation coupled with computerized lung sound analysis has the potential to improve diagnostic yield of pulmonary disorders in both clinical and research settings. More studies are needed to characterize recorded lung sounds, particularly in children. Furthermore, our study identified the need to address standardization of methodology and analytical methods across studies. This technology, however, faces a significant challenge before achieving clinical acceptance due to aforementioned lack of standardized clinical trials and lack of diagnostic validity.

[2] A new fusion model for classification of the lung diseases using genetic algorithm

C. Bhuvaneswari a,*, P. Aruna a, D. Loganathan b
a Department of Computer Science and Engineering, Annamalai University, Chidambaram, Tamil Nadu, India **b** Department of Computer Science and Engineering, Pondicherry Engineering College, Puducherry, India. Received 8 January 2014; revised 11 April 2014; accepted 5 May 2014

Available online 6 June 2014

In this work a novel fusion based feature extraction is proposed and feature selection is done by genetic algorithm that selects the top ranked features and classification is done through J48, KNN, MLP NN classifiers to classify the lung CT dataset. The algorithm has been designed based on the concept of texture and pixel co-efficient features. This method effectively works well for the detection of lung diseases with high sensitivity, specificity and accuracy. The classification accuracy for the tenfold cross validation method shows 85.96 for gabor filter, 77.19 for Walsh Hadamard transform and 91.53 for the proposed feature extraction method. Results show that MLP NN classifier with median absolute deviation techniques and genetic algorithm for feature selection yields better results. This justifies the choice of using fusion with the genetic algorithm with the classifier. This approach has potential for further development because of this simplicity that will motivate to classify the types of lung diseases. The developed classification system is expected to provide valuable diagnosis for the physicians. The work can further be extended by including more feature extraction and selection methods for classifying more lung diseases.

[3] A Critical Study of Classification Algorithms for LungCancer Disease Detection and Diagnosis

N.V. Ramana Murty[1] and Prof. M.S. Prasad Babu[2]

[1] Research Scholar, Rayalaseema University, Kurnool, Andhra Pradesh, India.

[2]Senior Professor, Department of CS&SE, AU College of Engg, Andhra University Visakhapatnam, AP, India.

In this paper a comparative study is done using the classification algorithms such as Naive Bayesian, RBF Neural Network, MLP network, Decision Tree and J48 algorithm for predicting the Lung Cancer Disease from the given dataset instances and the above proposed algorithms are applied on Lung Cancer Disease dataset in the WEKA tool and the performance is measured.

The analysis has been performed using WEKA tool with several data mining classification techniques and it is found that the Naive Bayesian algorithm gives a better performance in all aspects over the other classification algorithms. Lung cancer prediction system can be further enhanced and expanded. It can also incorporate other data mining

techniques, e.g., Time Series, Clustering and Association Rules. Continuous data can also be used.

[4] Classification of Lung Diseases by Image Processing Techniques Using Computed Tomography Images

C.Bhuvaneswari1, P.Aruna2, D.Loganathan3

In this work the pre-processing of the images are done then the feature extraction is done by moment invariants and the feature selection is done by the genetic algorithm and the naïve bayes and the decision tree classifiers are used to train, test and classify and the performance measure shows that the decision tree classifier produces more relevant results than the naïve bakes classifier. This work may be enhanced by taking some more lung diseases and more feature extraction methods can be employed and by combining with other classification models for obtaining more accurate results.

[5] RSIP Vision's Global Leader Processing & Computer Vision

RSIP Vision's Global Leader Processing & Computer Vision image processing expertise in medical imaging is currently used in numerous projects, including many applications of computer vision in pulmonology. They are very proud of our contribution to lung medicine: feature detection, lung segmentation and countless other works in the pulmonary imaging field enabled our clients to give the means to physicians to save lives by giving faster and more appropriate treatment to all kind of lung diseases. You can read below about some of our breakthrough developments in Pulmonology and Bronchoscopy.

[6] A study on Deep Machine Learning Algorithms for diagnosis of diseases

Dinu A.J.*, Ganesan R1, Felix Joseph2 and Balaji V3
*Research Scholar, Noorul Islam University, Kumaracoil, Thuckalay, Tamil Nadu, India.
1 Professor, Department of Electronics and Instrumentation Engineering, Noorul Islam University, India.
2 Department of Electrical and Computer Engineering, Bule Hora University, Ethiopia.
3 Faculty of Electrical and Computer Engineering, Jimma Institute of Technology, Jimma University, Ethiopia.

This paper provides an idea of recent artificial intelligent systems available for detection and diagnosis of different diseases. The system analyzes the relevant medical imagery and associated point data to make an inference that can help the doctor make a decision in a clinical situation. The AI system just works as an interface between clinical image flow and archived

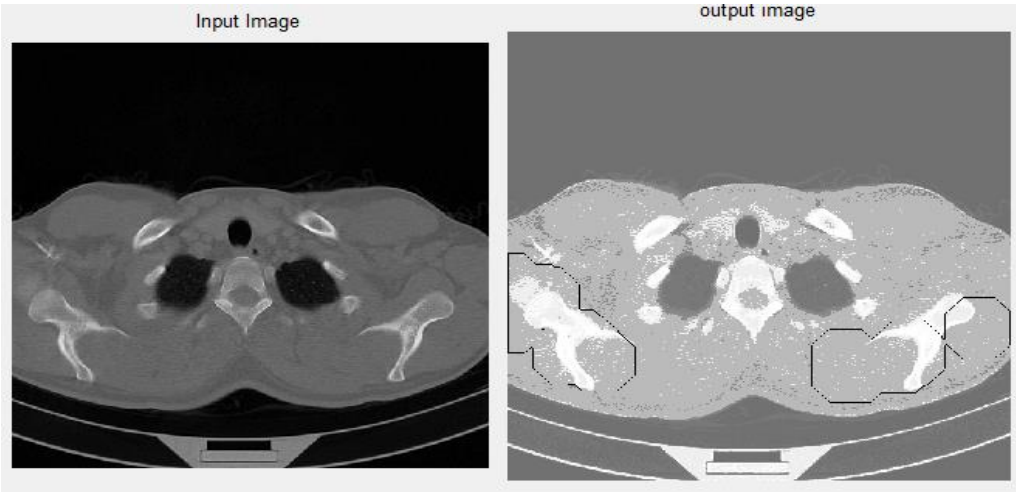
image data. The AI system does not require application-specific engineering to apply it. The various disease diagnosis using AI systems can increase the speed of decision making, and it can lower the false-positive rates. From the study it can be clearly observed that different AI algorithms provide enhanced accuracy on detection of various diseases.

[7] IDENTIFYING LUNG CANCER IN ITS EARLY STAGE USING NEURAL NETWORK AND GA ALGORITHM

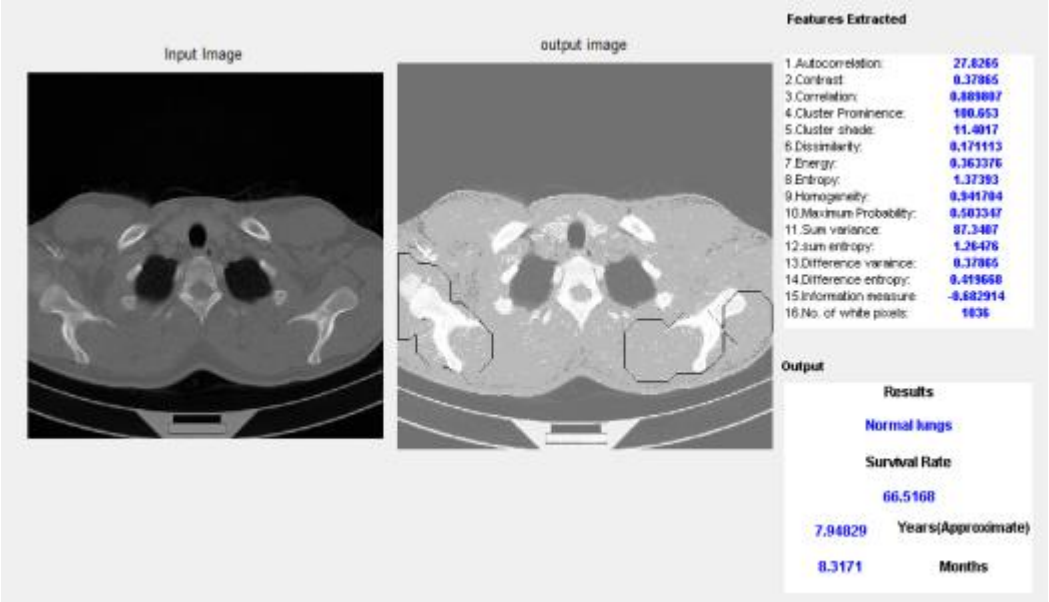
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 4 Issue 2, February 2015

Nancy,Paramjit Kaur

Early detection of cancer can be helpful in curing the disease completely. So the requirement of techniques to detect the occurrence of cancer nodule in early stage is increasing. Neural Networks play a vital role in automating the classification process for early detection of Lung Cancer. Prognosis of early diagnosis of Lung cancer with BPNN models has the best performance in large data sets and for more accuracy, after that result has been passed through GA algorithm for optimization. **Fig**.

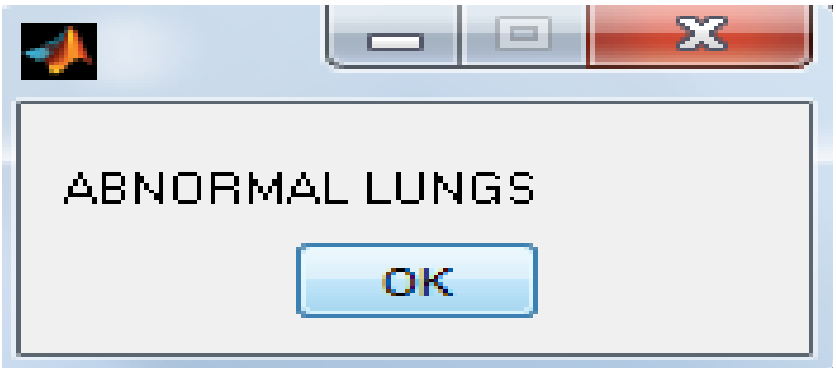


After the feature extraction, classification is done. **Fig**.



On the basis of features extracted, classification has been done, that either lung belongs to normal or abnormal section.

Fig: Classification using Neural Network has been done, and from the features extracted, we came to know that lung finds out abnormal.



Future Scope of this paper lies in the technique where we can use BFO, Bacterial foraging optimization algorithm (BFOA) has been widely accepted as a global optimization algorithm of current interest for distributed optimization and control. BFOA is inspired by the social foraging behavior of *Escherichia coli*. BFOA has already drawn the attention of researchers because of

its efficiency in solving real-world optimization problems arising in several application domains.

[8] Computer-Assisted Detection of Infectious Lung Diseases: A Review

Ulas Bagci,
Center for Infectious Disease Imaging, Department of Radiology and Imaging Sciences, National Institutes of Health (NIH), Bethesda, Maryland 20892
Mike Bray,
National Institute of Allergy and Infectious Diseases, National Institutes of Health (NIH), Bethesda, Maryland 20892
Jesus Caban,
National Library of Medicine, National Institutes of Health (NIH), Bethesda, Maryland 20892
Jianhua Yao, and
Department of Radiology and Imaging Sciences, National Institutes of Health (NIH), Bethesda, Maryland 20892
Daniel J. Mollura
Center for Infectious Disease Imaging, Department of Radiology and Imaging Sciences, National Institutes of Health (NIH), Bethesda, Maryland 20892

Respiratory tract infections are a leading cause of death and disability worldwide. Although radiology serves as a primary diagnostic method for assessing respiratory tract infections, visual analysis of chest radiographs and computed tomography (CT) scans is restricted by low specificity for causal infectious organisms and a limited capacity to assess severity and predict patient outcomes. These limitations suggest that computer-assisted detection (CAD) could make a valuable contribution to the management of respiratory tract infections by assisting in the early recognition of pulmonary parenchymal lesions, providing quantitative measures of disease severity and assessing the response to therapy. In this paper, we review the most common radiographic and CT features of respiratory tract infections, discuss the challenges of defining and measuring these disorders with CAD, and propose some strategies to address these challenges. CAD systems can be applied to the imaging of respiratory tract infections by following by two basic analyses: imaging findings from infectious diseases in general (i.e. texture and shape patterns) and computerized recognition of those findings in a computational platform. In discussing the first step, we have focused on texture and shape patterns seen in pulmonary infections such as TB or H1N1 influenza. For the second, we have manifested computational tools such as feature extraction and classifier design that are required to design a robust and successful CAD system.

[9] Lung-Deep: A Computerized Tool for Detection of Lung Nodule Patterns using Deep Learning Algorithms : Detection of Lung Nodules Patterns
Qaisar Abbas , College of Computer and Information Sciences,
Al Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia

A new computerized lung-nodules pattern detection system using multilayer deep learning algorithms is developed in this paper for the early diagnosis of lung cancer or lung-related disease. The proposed Lung-deep system is better than state-of-the-art systems due to use of latest machine learning techniques without using complex image processing algorithms. A dataset of 3250 lung nodules are utilized in this study to test the performance of proposed Lung-Deep system.

Worldwide, the early detection of lung cancer improves the patient survival rate and therefore in this study, an improved computerized system is proposed to classify lung nodules without clinical experts. Accordingly, the major contribution of this development lies in the application and analysis of two variants of deep learning architectures for classification of six lung nodules disease patterns. The developed system was tested and evaluated on the LIDC/IDRI database and the best result was achieved. For detection of six different patterns on LIDC/IDRI dataset, a good performance is obtained in terms of sensitivity, specificity, and area under ROC curve about 88%, 80%, and 89%, respectively. It outperforming the results obtained by using of variants of deep learning techniques. It is important to classify lung nodules into benign and malignant based on disease patterns that will be focused in the future work. In addition to this, the segmentation of lung nodules will be automatically performed [22] compared to the use of manual segmentation in this study done by an expert radiologist. Hence, the development of this CAD tool for pattern classification is having a great clinical importance and it assists radiologists to better identify the lung-related disease.

[10] Respiratory disease - Britannica Online Encyclopedia

[11] The Top 8 Respiratory Illnesses and Diseases disease - Wikipedia Online

4. OBJECTIVES :

1. To contribute the medical domain with the existing technology to make it more reliable and efficient.
2. To study the diseases associate with the lungs in detail and provide image and pattern recognition solutions for disease identification and grading
3. To learn image and pattern recognition softwares like Matlab, R, Open CV, Python.
4. To learn different imaging modalities associated with medical radiology.

5. METHODOLOGY :

The steps followed in the prospective research work is as follows:

1. Decide on the disease of the lungs and the imaging modality (whether MRI, PET, CT or so on)

2. Acquire the image and obtain the pre-processing of the image

3. Extract the features from the image and pass it to the classification stage-1. This stage identifies whether the lung is diseased or not. For this sophisticated machine learning algorithms can be used. Identification of a good algorithm is the research issue of this step.

4. If the image belongs to not-diseased category, the algorithm notifies the user and ends, else the algorithm continues to the next stage. The diseased image is passed on to the next stage, which identifies which disease the lung is affected with. Identifying the disease and the number of diseases to train the machine-learning algorithm is the research issue of this stage.

5. I use another machine-learning algorithm to grade the disease according to standards maintained by clinical practitioners.

Totally, I use three machine learning algorithms at different stages to obtain the required results.

6. IMPORTANCE OF THE PROPOSED WORK :

As we move into the new millennium it is becoming increasingly clear that the biomedical sciences are entering the most exciting phase of their development. Paradoxically, medical practice is also passing through a phase of increasing uncertainty, in both industrial and

developing countries. Industrial countries have not been able to solve the problem of the spiraling costs of health care resulting from technological development, public expectations, and—in particular—the rapidly increasing size of their elderly populations. The people of many developing countries are still living in dire poverty with dysfunctional health care systems and extremely limited access to basic medical care.

Against this complex background, this study examines the role of science and technology for disease control in the past and present and assesses the potential of the remarkable developments in the basic biomedical sciences for global health care.

With the advancement of computational science, it has been made possible to develop methodologies for epidemic simulation. There is evidence that compared to coarse-grained input data, when higher resolution contact pattern data is integrated in a computational model, the size of the epidemic is more accurately reproduced and at risk groups are more appropriately identified.

Computational approaches also help determine the characteristics and magnitude of data needed to be collected and integrated into the mathematical frameworks in order to increase the reliability and accuracy of large-scale infectious diseases modeling.

Using pattern recognition techniques, it has been shown how to identify the lung diseases and its severity grading.

7. SCOPE OF THE STUDY :

In this work a novel fusion based feature extraction is proposed and feature selection is done by pattern recognition algorithm that selects the top ranked features and classification is done through J48, KNN, MLP NN classifiers to classify the lung CT dataset. The algorithm has been designed based on the concept of texture and pixel co-efficient features. This method effectively works well for the detection of lung diseases with high sensitivity, specificity and accuracy. The classification accuracy for the tenfold cross validation method shows 85.96 for gabor filter, 77.19 for Walsh Hadamard transform and 91.53 for the proposed feature extraction method. Results show that MLP NN classifier with median absolute deviation techniques and pattern recognition algorithm for feature selection yields better results. This justifies the choice

of using fusion with the pattern recognition algorithm with the classifier. This approach has potential for further development because of this simplicity that will motivate to classify the types of lung diseases. The developed classification system is expected to provide valuable diagnosis for the physicians. The work can further be extended by including more feature extraction and selection methods for classifying more lung diseases.

8. PROPOSED WORK PLAN:

To complete the study in time it is decided to go through the following work plan phases.

Phase 1. : Submission of synopsis to the institute Swami Ramanand Teerth Marathwada University.

Phase 2. : Preparation of required data to carry the study and deciding criteria.

Phase 3. : Data Selection and Transformation

Phase 4. : Employ advanced clustering algorithm for mining the required data from the available data base.

Phase 5.: Various parameters in relation to students success will be analysed and extracted based on which the prediction approach will be carried out.

Phase 6.: Once the parameters are extracted, they will be fed to the classifier for predicting the success rate of the student. Here we employ advanced machine learning techniques for prediction.

Phase 7.: The performance of proposed approach will be then measured by calculating various evaluation parameters and then compared with existing approach for proving the efficiency.

9. TENTATIVE CHAPTER SCHEME :

Chapter1. Abstract and Introduction

Chapter 2. Literature Review

Chapter 3. Methodology

Chapter 4. Clustering algorithm for pattern recognition & image processing and various

techniques

Chapter 5. Empirical work

Chapter 6. Result and Conclusion

10. YEAR WISE PLAN OF WORK AND TARGETS TO BE ACHIEVED :

The table given below explains the year wise plan of work.

Phases	Expected work	Expected duration in months
Phase1	Research proposal, Abstract, Introduction,	3
Phase1	Literature review	3
Phase1	Deciding Technique and Preparation of data	6
Phase1	Applying the method and obtain the outcome	6
Phase1	Thesis Binding	3
Phase1	Other related work	3

11. EXPECTED OUTCOME :

Proposed approach will be then measured by giving image and our designed algorithm will identify and grade the disease in the lung. The results will be justified using graphs and suitable parameters.

12. REFERENCES :

[1] Graham R, Perriss R, Scarsbrook A. Dicom demystified: a review of digital file formats and their use in radiological practice. Clin Radiol 2005:1133–40.

[2] Kalender WA. Computed tomography: fundamentals, system technology, image quality, applications. 3rd ed. Erlangen: Publicis Publishing; 2011.
[3] Pugatch RD, Faling LJ. Computed tomography of the thorax: a status report. Chest 1981;80:618–26.
[4] Chabat, F, Hansell DM, Yang GZ. CT lung image classification with correction for perfusion gradient. In: 7th international conference on image processing and its applications; January 1999. p. 402–406.
[5] Mathew TV. Pattern recognition algorithm. Bombay, Mumbai: Indian Institute of Technology; 1996.
[6] Sastry K, Goldberg D, Kendall G. Pattern recognition algorithms. In: burke E, kendall G, editors. Search methodologies-introductory tutorials in optimization and decision support techniques. Berlin: Springer; 2005. p. 97–125 [Chapter 4].
[7] Computerized lung sound analysis as diagnostic aid for the detection of abnormal lung sounds: A systematic review and meta-analysis
Arati Gurung [a], Carolyn G. Scrafford [b], James M. Tielsch [b], Orin S. Levine [b], William Checkley [a,b],*
a Division of Pulmonary and Critical Care, School of Medicine, Johns Hopkins University, Baltimore, MD, USA b Program in Global Disease Epidemiology and Control, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA Received 11 March 2011; accepted 11 May 2011 Available online 14 June 2011
[8] A new fusion model for classification of the lung diseases using genetic algorithm
C. Bhuvaneswari a,*, P. Aruna a, D. Loganathan b
a Department of Computer Science and Engineering, Annamalai University, Chidambaram, Tamil Nadu, India **b** Department of Computer Science and Engineering, Pondicherry Engineering College, Puducherry, India. Received 8 January 2014; revised 11 April 2014; accepted 5 May 2014 Available online 6 June 2014
[9] A Critical Study of Classification Algorithms for LungCancer Disease Detection and Diagnosis
N.V. Ramana Murty1 and Prof. M.S. Prasad Babu2
1 Research Scholar, Rayalaseema University, Kurnool, Andhra Pradesh, India.
2Senior Professor, Department of CS&SE, AU College of Engg, Andhra University Visakhapatnam, AP,
[10] Classification of Lung Diseases by Image Processing Techniques Using Computed Tomography Images
C.Bhuvaneswari1, P.Aruna2, D.Loganathan3
[11] RSIP Vision's Global Leader Processing & Computer Vision
[12] A study on Deep Machine Learning Algorithms for diagnosis of diseases
Dinu A.J.*, Ganesan R1, Felix Joseph2 and Balaji V3
*Research Scholar, Noorul Islam University, Kumaracoil, Thuckalay, Tamil Nadu, India.
1 Professor, Department of Electronics and Instrumentation Engineering, Noorul Islam University, India.
2 Department of Electrical and Computer Engineering, Bule Hora University, Ethiopia.
3 Faculty of Electrical and Computer Engineering, Jimma Institute of Technology, Jimma University, Ethiopia.

[13] IDENTIFYING LUNG CANCER IN ITS EARLY STAGE USING NEURAL NETWORK AND GA ALGORITHM
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue 2, February 2015 Nancy,Paramjit Kaur

[14] Computer-Assisted Detection of Infectious Lung Diseases: A Review
Ulas Bagci, Center for Infectious Disease Imaging, Department of Radiology and Imaging Sciences, National Institutes of Health (NIH), Bethesda, Maryland 20892
Mike Bray, National Institute of Allergy and Infectious Diseases, National Institutes of Health (NIH), Bethesda, Maryland 20892
Jesus Caban, National Library of Medicine, National Institutes of Health (NIH), Bethesda, Maryland 20892
Jianhua Yao, Department of Radiology and Imaging Sciences, National Institutes of Health (NIH), Bethesda, Maryland 20892
Daniel J. Mollura Center for Infectious Disease Imaging, Department of Radiology and Imaging Sciences, National Institutes of Health (NIH), Bethesda, Maryland 20892

[15] Lung-Deep: A Computerized Tool for Detection of Lung Nodule Patterns using Deep Learning Algorithms : Detection of Lung Nodules Patterns
Qaisar Abbas , College of Computer and Information Sciences,
Al Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia

[16] Golberg DE. Pattern recognition algorithms in search, optimization and machine learning. Reading MA: Addison Wesley; 1989.

[17] Golberg DE. Pattern recognition algorithms in Graham R, Perriss R, Scarsbrook A. Dicom demystified: a review of digital file formats and their use in radiological practice. Clin Radiol 2005;60:1133–40.

[18] Respiratory disease - Britannica Online Encyclopedia

[19] The Top 8 Respiratory Illnesses and Diseases disease - Wikipedia Online

Mr. Arunkumar Chandan
Research Scholar

Dr. Sudhir B.Jagtap
Professor
Swami Vivekanand Mahavidyalay
Udgir, Dist:Latur